

20050218157  
ID 63697

## INFORMATION PROCESSING OPERATIONS AND PROBLEMS AT THE AFCRL RESEARCH LIBRARY

B. A. Lipetz, D. E. Sparks, and L. F. Buckland

Research Division  
Itek Corporation  
Lexington 73, Massachusetts

Special Report No. 1 (revised)  
Contract AF 19(604)8438

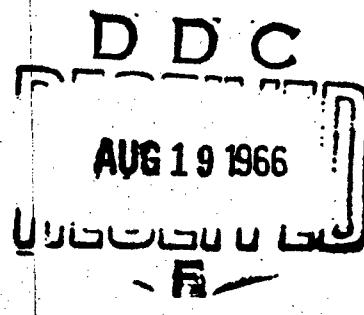
July 1961

Prepared for

ELECTRONIC RESEARCH DIRECTORATE  
AIR FORCE CAMBRIDGE RESEARCH LABORATORIES (AFCRL)  
AIR FORCE OFFICE OF AEROSPACE RESEARCH (AFOAR)  
UNITED STATES AIR FORCE  
BEDFORD, MASSACHUSETTS

20050218157

Best Available Copy



## TABLE OF CONTENTS

1. Introduction	1
2. The AFCRL Scientific Library	4
3. Functions	6
4. Problems and Approaches	20
5. Recommendations	25

## 1. INTRODUCTION

This report discusses the applicability of automatic data-processing techniques to one particular Air Force scientific library, and the implications of machine-assisted cooperation among many scientific information handling groups.

Adoption of automatic data-processing techniques by information-handling groups has been quite limited. Know-how about these techniques does not diffuse rapidly through an entire profession. Most potential users of new methods tend to hold back until they can observe such innovations in use elsewhere, and only then adopt or improve them.

However, lack of know-how is not the only deterrent. As some of the less cautious information-processing groups have found to their sorrow, there are limits to machine capabilities. Unless these limitations are thoroughly appreciated, it is possible that new equipment will demand more manual effort than it eliminates.

Equipment cost is another important factor. In the comparatively few locations where libraries make use of computers, they are generally "junior partners", taking advantage of surplus time on computers originally purchased for other applications. However, some applications are far less attractive than others. For example,

searches of large information collections may be performed on simpler equipment, but such searches would be completely impractical because of excessive search time.

Another factor is the compatibility of new methods with old environments. Library records represent the sustained effort of many people over many years. Converting conventional catalog cards to a mechanized form is in itself an enormous task. Manual and mechanical records must exist side by side for some extended period until the manual records can be converted to machine-usable form. To forestall the inconvenience to users of working with two systems, the introduction of new techniques should be planned so that the manual system remains current and operational during the conversion period. When the records have all been converted and the new system has been tested, the manual system is then abandoned. Machine-usable records should be designed for easy machine conversion and so that they can be read by other machine systems.

Worthwhile improvements in effectiveness and cost of library and information center operations may be achieved now, even in quite small libraries, through the introduction of inexpensive data-processing equipment, provided the equipment is selected to blend with current manual practices. Furthermore, useful exchange of machine usable records among libraries can be effected through adoption of standardized record-keeping practices. Pilot operations toward this end are functioning successfully at Itek. The far-reaching implications of such exchange operations for improving dissemination of knowledge have been discussed in the literature. A significant development is the automated search and retrieval system now evolving at the Armed Services Technical Information Agency; while not specifically intended to promote records exchange, the new system appears to be inherently capable in this regard.

On-the-spot studies have been conducted at the AFCRL Research Library to observe operations and records directly. Mr. Ole Groos, Librarian, and his staff have been exceedingly helpful, and very frank in explaining their procedures and problems.

## 2. THE AFCRL SCIENTIFIC LIBRARY

The AFCRL Library is officially the Research Library Branch, Research Information Division, Electronics Research Directorate, Office of Aerospace Research. It is organized to serve the scientific community at the Laboratories in their basic mission of research in geophysics and electronic communication. In addition, the Library serves a wider Air Force clientele in these and associated fields, maintaining for this purpose thirty-two off-site collections throughout the world.

The Library staff of 29 persons is divided as follows:

1. Office of the Librarian: 4 persons
2. Acquisitions Section: 4 persons
3. Processing Section: 8 persons
4. Reference and Circulation Section: 9 persons
5. Technical Reports Distribution Section: 4 persons

The Library comprises some 180,000 textbooks and bound-journal volumes, over 3,200 journal subscriptions, and approximately 270,000 technical reports, with an annual growth of 2,250 textbooks, 30,000 issues of journals, and 25,000 technical reports.

Input of scientific information consists mainly of textbooks, serial publications, and technical reports. However, pamphlets and off-prints are often given away.

Many textbooks which belong to well defined publishers' series, or are issued as members of a laboratory series, are treated as if they were serials, both in the cataloging and in storage. Technical reports are received by automatic distribution, and, less frequently, by specific request. These reports comprise both internally generated reports of Government agencies and reports of contractors to those agencies.

### **3. FUNCTIONS**

There are four basic Library functions involved in Servicing a scientific community:

1. Decision to acquire
2. Action to procure
3. Incorporation into collection
4. Dissemination

These functions vary in complexity according to the type of bibliographic material handled, the internal bibliographical control aimed at, and the relationship of the Library with external jurisdictions which control or serve it. For example, the processes used to implement "Action to Procure" are directly affected by the relationship of the Library to Air Force procurement office regulations.

At AFCRL Research Library, there are five main information-processing activities which implement these functions:

1. Selection
2. Acquisition
3. Cataloging and announcement
4. Circulation
5. Distribution

Performance of some of these processes is often restricted to a single organizational section of the Library (Acquisitions, Processing, Reference, and Circulation, Technical Reports Distribution).

## SELECTION

Selection and acquisition activities have been major efforts of the AFCRL Research Library during its formative years. The Library makes an effort to be comprehensive in collecting both currently published and older materials. However, the present selection process is not highly organized. It is spread among members of several sections, sometimes on the basis of administrative responsibility, and sometimes on the basis of familiarity with a given subject or language.

The Library's patrons play a minor role in the selection process. Some input in the form of requests for specific items is received, and may result in orders. But most orders are the result of the staff's aggressive selection activities. That this action pays off is demonstrated by the report of Reference personnel that they are able to fill eighty per cent of patron requests off the shelf. However, scientific personnel have no opportunity to contribute evaluative judgments of the purchase decision; only general guidance is given the Library through the AFCRL Advisory Library Committee.

## PROCUREMENT

Administratively, procurement is closely associated with selection; it falls under the jurisdiction of the Acquisition Section. Functionally, procurement can be divided into four activities:

1. Verification
2. Purchasing
3. Receiving
4. Accepting gifts

The verification process consists mainly of successive look-up activities and decisions based on duplication.

In verifying a selection, a number of different files must be searched. By consolidating several of the overlapping files, verification routines could be simplified.

The next step in the procurement process is purchasing. Because of regulations, this process involves a complex sequence of routines and alternate routines. The basic process consists of preparing purchase request forms from the on-order cards, getting proper approval, transmitting them to the purchasing authority, and filing and storing copies of all orders by item and purchasing activity numbers.

The process as described is complicated by the existence of two sources of funds available to the Library:

1. "Central" funds: funds available from Air Force central procurement, Air Materiel Command, and Wright Patterson Air Force Base.
2. "Local" funds: funds available through local procurement offices. Two local procurement offices serve the Library: the Procurement Office of the Electronic Systems Division (ESD), and the Procurement Office of the Electronics Research Directorate (ERD).

A further complication arises from the fact that the ERD Procurement Office permits the Library to place its own "Request for Quotation" direct to certain vendors under certain circumstances. As a consequence of various funding and procurement sources, four separate purchasing routines exist. Each of these purchasing routines involves the use of different forms required by outside authorities; however, all forms can be made to accept identical data.

The number of copies required for each order form varies according to the specific fund used. Staff experience is also a factor in the number of copies prepared at the original typing, since receipt of partial shipments is facilitated by extra copies. The highest number of copies in any given purchase routine is five plus original.

The files of order records are arranged by fund or order activity and subfiled by specific order or purchase request number. These files form a complete record of the order activity of the Library, including both pending and completed orders. Purchase records are updated by feedback from purchasing authorities and vendors.

Subscriptions renewal activity takes place once each year under considerable time pressure. It is unusual in a library with such a large subscription portfolio for subscription renewal routines to be performed year by year. However, "till forbidden" service through standing orders placed with a competent periodicals jobber is not available to the Library because Government regulations demand competitive bidding on large orders.

The final steps in the procurement process are the receiving of shipments of ordered materials and the clearing of acquisition records. These routines involve inspection and acceptance of books, etc., clearing related purchase records, and preparation of the required voucher forms. Again, this process is made complex because of the multiple purchasing routines and the lack of integrated files. The preparation voucher records further complicate and delay the process.

An extensive exchange program is maintained by the Library with a number of universities, research institutes, and Government installations. Materials exchanged are AFCRL reports and contractor research results. Exchange relationships are established by the Acquisition Section.

Verification and follow-up procedures are not highly formalized, but special receiving procedures are required for classified material.

#### CATALOGING AND ANNOUNCING

The Processing Section receives materials directly from the Acquisitions Section. A copy of the receiving voucher accompanies purchased material. Routines performed by the Processing Section include:

1. Precataloging
2. Cataloging
3. Announcements
4. Binding

Cooperation between Acquisition and Processing is minimal. Many of the records prepared by Processing duplicate and overlap records prepared by Acquisitions. No attempt is made to coordinate and re-use the records produced by the different sections. A significant savings could be effected if these activities were coordinated.

Materials are separated into three categories -- monographs, serials, and documents, each of which undergoes different processing.

Monographs are further separated into four processing groups:

1. those requiring only book preparation
2. those requiring only preparation as added copies
3. those to be cataloged upon receipt of Library of Congress cards
4. those requiring immediate original cataloging

Most items received by monograph cataloging personnel require procurement of Library of Congress (LC) cards. Therefore, the majority of routines in the total monograph cataloging process relate to LC card-order activities; nonavailability of LC cards necessitates original cataloging. LC card ordering is not always simple; repeated and expensive recycling is often necessary, entailing serious delays in the completion of cataloging.

Original cataloging is a minor part of the present monograph cataloging process, and is undertaken only when LC cards are not available. Nonavailability of LC cards is not immediately or simply ascertained. Often, it is discovered only after several attempts have been made to order cards. This, in part, accounts for the complexity and delay in LC card ordering routines.

Serials cataloging differs from monograph cataloging in a number of ways. Serials are arranged alphabetically by main entry; they are not classified or analyzed for subject content. The public catalog records for serials is a "locator file" made up of main-entry card only -- a holdings record is maintained by the serials cataloger.

The document card category has nine main divisions; in addition, certain auxiliary files related to the document collection are maintained. Document cataloging is restricted almost entirely to descriptive cataloging. All documents entering the collection pass through cataloging with the exception of documents received from NASA and WADD.

Announcement of new materials entering the collections is accomplished in three ways:

1. selective accessions list for monographs
2. complete accessions list for documents
3. AFOSR Quarterly Index of Technical Documentary Reports

Each of these lists is prepared either by retyping original entries or photographically reproducing catalog card entries. No data processing machines or techniques are used.

#### CIRCULATION AND DISTRIBUTION

Circulation procedures are simple and essentially identical for all materials. This system is operated by the Reference and Circulation Section.

A number of satellite collections duplicating small parts of the main collection are held by the Library at various field stations. Control of these collections is maintained by "Memorandum Receipt" accounts.

The Library is also charged with the responsibility of distributing bibliographical materials generated by Air Force Cambridge Research Laboratories. This function is carried out by two separate operations:

1. Technical Reports Distribution Section (TRDS) performs most of the distribution undertaken by the Research Information Division. Materials handled by TRDS include reports generated internally by AFCRL, by foreign contractors to AFCRL, and reports generated by domestic contractors to AFCRL. TRDS also has the responsibility of controlling classified reports.

2. Primary distribution of reports generated by domestic contractors to AFCRL is supervised by a staff attached to the Research Information Division's administrative office. This operation does not include the actual distribution of the contractor's reports, but does include the maintenance of distribution records and the provisions of distribution instructions to the contractor.

Both of these operations are performed by two sets of routines. One routine maintains a master file of addressees and their addresses. The other routine selects addresses from this master list to form a distribution list for a given report. The interaction of these two routines is complex, particularly so in the necessity for updating the master file (deletions, additions, and changes of address) and by an administrative policy which permits contract monitors and laboratory chiefs to frequently manipulate the content of distribution lists.

The address files used for these two operations overlap. Both make use of master stores of addresses (either on cards or Addressograph plates). As a consequence, updating routines are complicated and require coordination and exchange of information between the two activities.

Administrative data concerning the contracts under which reports are generated is maintained by Research Information Headquarters. These data relate to projects, tasks, personnel, etc.

An activity which is related to the Library distribution function is performed by Acquisitions as part of its exchange program. The Library exchanges papers and technical reports with interested universities, experiment stations, and societies. Some of these exchange arrangements require automatic distribution of AFCRL reports. This in turn requires that a separate address file be kept which duplicates in part the files maintained by TRDS.

#### INFORMATION INTERCHANGE

A number of information systems in other Government groups and agencies which supply or receive information from the AFCRL Research Library involve straightforward exchange of administrative or fiscal information, as with the Library's parent organization, the

Research Information Division of ERD, or with the purchasing offices of ERD and AMC. Exchange with other information systems (ASTIA, OAR, LC) is in the form of scientific information or bibliographic descriptions of scientific information. These exchanges are extremely important in influencing the nature and extent of the Library's scientific information services. Before data processing can be introduced, one must consider the effect it will have on these other organizations and in their exchange relationships.

Scientific information with ASTIA goes in both directions. As the distributor of in-house AFCRL technical exchange reports, the Library's parent organization supervises the distribution of AFCRL's contractors' technical reports to ASTIA. All AFCRL technical reports contain abstracts.

ASTIA, in turn, distributes its accessions list, the Technical Abstract Bulletin (TAB), which provides abstracts and detailed information on tens of thousands of newly available reports each year. Upon request, ASTIA supplies the Library with copies of its reports, and performs bibliographic searches.

There are obvious similarities between the work performed at the Library in cataloging reports and the work performed at ASTIA in preparing text for TAB. In both cases, records must be prepared which include thorough bibliographic description, subject indexing, and security classification. Each information system assigns its own accession number. The ASTIA record includes several additional categories of data not presently found in the Library's Record: for example, a technical abstract is easily available to the Library in most of the reports which it catalogs, but is not currently being copied. Subject indexing by ASTIA is more highly developed, following a published descriptor system which is of potential value as a standard to be followed in cataloging documents.

Recently, ASTIA has begun to use data-processing equipment in preparing information for inclusion in TAB and in its search files. The records are prepared in machine-readable form on tape-producing, tape-reading typewriters. It seems highly desirable to use similar machines for internal record-producing operations at the Library. The machine systems in the two locations should be made compatible to promote beneficial exchange of machine-readable information. For example, it is conceivable that ASTIA could eliminate considerable human cataloging and typing effort if it received from AFCRL a machine-readable (punched tape) version of the cataloging records along with requested reports. Going even further, cumulative files of machine-readable records might be duplicated and exchanged for search purposes to relieve centralized search facilities.

Study and observation of ASTIA and of Library requirements have established that there is no technical problem which would prevent useful interchange of machine-readable records. There would be some minor changes in ASTIA's machine encoding practice, since not all of the categories of recorded data which are of particular interest to the Library for cataloging purposes can at present be identified for selection by machine within the larger ASTIA punched-tape record. From ASTIA's viewpoint, any machine-interpretable cataloging records received from the Library might be more valuable if they included a technical abstract and full subject indexing. Such changes would tend to shift the burden of report cataloging from the ultimate distributing agency (ASTIA) to the originating agency. Librarians disagree as to the relative adequacy of results which can be expected from such a shift, but an objective evaluation seems possible.

The Library receives technical reports from many sources other than AFCRL and ASTIA. It is on the distribution lists of many research-sponsoring agencies in the Air Force, DOD, AEC, NASA, the Commerce Department, and foreign governments.

Most of these agencies also maintain document libraries and issue acquisitions lists, which requires them to prepare bibliographic descriptions and catalog records of their reports. The potential benefits of receiving machine-interpretable catalog records along with reports from ASTIA applies equally to reports received on direct distribution from other agencies. If all report-producing agencies were able to supply machine-interpretable catalog records, large savings in document cataloging effort could be effected. Even greater savings in effort might result at such distributing centers such as ASTIA and AEC's Technical Information Division. However, we do not know of any report-producing agencies which offer machine-interpretable catalog records to report recipients. Reciprocally, an information processing organization such as the Library could send out machine-interpretable records along with AFCRL reports to other agencies, as well as utilize such records from other agencies.

Exchange of scientific information with LC is almost entirely one way. While the Library occasionally provides information on its unusual periodical holdings to LC for inclusion in a union serials catalog, it makes constant use of LC catalog cards and cataloging authorities in the processing of newly accessioned monographs. The book catalog at the Library is composed partly of cards bought from LC, and partly of cards produced locally according to modified LC standards.

Although LC is beginning to give some thought to the possibilities of data-processing equipment, it is not at present producing LC cards in machine-readable form. This means that any data-processing program at the Library would always involve manual retying of LC cards. This requirement, added to the effort involved in obtaining LC cards could outweigh the value of continued use of LC cards. It might well become preferable for the Library to do original cataloging of most books.

Ideally, duplication of original cataloging and card typing could be avoided if LC distributed machine-interpretable catalog records. Work performed on the present contract should contribute to the design of a catalog record service system compatible with machine systems required by local libraries.

The Library and other associated libraries might contribute to union cataloging efforts such as those sponsored by LC by supplying information on local collections in machine-interpretable media. If incoming records were compatible, compilation and updating of listings could be effected quickly. Suitable machine-interpretable records might be derived as by-products of normal cataloging and accessioning activities in local libraries.

The directorates, which constitute AFCRL, report various types of information to their parent organization, AFOAR. Regular reporting of information on new AFCRL technical reports is performed by the Library and by the headquarters staff of its parent organization, the Research Information Division. As new internal AFCRL or contractor reports are distributed, descriptive information is sent to the library of another AFOAR subordinate, Air Force Office of Scientific Research (AFOSR). There it is merged with information submitted by other AFOAR research organizations to appear in the publication "Quarterly Index of Technical Documentary Reports". The "Quarterly Index" is disseminated throughout the military establishment. Reports descriptions are listed in order by the research project under which they were authorized; various quarterly and annual cross indexes are also included.

From the technical reports submitted to it by AFCRL and similar subordinate agencies, AFOAR plans to prepare and distribute an annual cumulation of abstracts of these reports, with cross indexing included, covering past as well as current years.

One such volume has already been completed and another is in preparation. The work is being done by LC's Science -Technology Division at the request of the Mathematical Sciences Directorate of AFOAR. While the first volume was prepared for printing with ordinary typewriters, the second is being prepared with tape-typewriters. This machine is being used to facilitate revision of copy in manuscript preparation. Some thought has been given to the possibility of having copies of these machine-readable records made available to research groups for experimental use. However, no thought appears to have been given yet to making the categories of data included in the records machine-identifiable.

A third type of compilation being prepared by AFOAR's Mathematical Sciences Directorate is an annual collection of summaries of AFOAR basic research projects. In the latest volume, a punched-tape typewriter was used to prepare the manuscript. The information used in this compilation is condensed from DOD Form 613C, the prescribed standard form for outlining research activity. At AFCRL, these forms are prepared outside the Library; they are mentioned here only because they are exploited at AFOAR in almost the same manner as technical reports and report descriptions.

In all of the aforementioned instances of scientific information exchange, the pattern is similar; individual research organizations such as AFCRL transmit copies of locally produced records to headquarters, which compiles and publishes a summary. There could clearly be benefits for the headquarters group if local data were received as machine-interpretable records. Records could then be merged by machine, and routine compilations, evaluations, and searches made automatically with little human effort. Pertinent selections from the received records in machine-interpretable form would facilitate incorporation into the catalogs of individual research organizations.

There is also a regular flow of management information pertaining to research projects and contracts -- costs and budgets, tangible project objectives, project fulfillment, etc. At AFOAR, information of this kind is now being converted upon receipt, under Project Echo, to a machine-readable record which can be searched or summarized automatically.

Machine-interpretable reports from AFOAR branches would be beneficial to AFOAR to replace the transcribing of incoming data. Branches would also benefit, if the volume and use of local management information processing warranted using data-processing equipment.

#### 4. PROBLEMS AND APPROACHES

The Library's mission, as noted before, is to provide scientific information which can be utilized by AFCRL's research community and certain other Air Force groups. In carrying out this mission, two mutually-restrictive problems always arise: (1) the desire to expand the depth and kind of service, vs. (2) the desire to provide any particular service more economically. An economical service is more likely to receive administrative support and emphasis. Thus, the incentive in the Library should be to seek long-range ways of improving the efficiency of its services. Problems arise, however, when a library is unable to provide or continue all of the specific services which are expected or desired of it by the administrative level.

In addition to these long-range problems, the staff of the AFCRL Research Library is concerned with a number of immediate problems. An obvious area of current concern in the Library is the input processing backlog on monographs and documents. In the past, major emphasis has been on building the collection. However, cataloging of these materials has not kept up with the acquisitions. Putting material in the collection without bibliographical control would be relatively useless to the Library's patrons. Material is added to the backlog of monograph cataloging under priority decisions at the time that a book is received. These decisions are effected by problems of language, a tendency to delay or avoid original cataloging, and lengthy built-in delays to the cataloging routine. About 40,000 volumes (close to half the monograph collection) are not fully cataloged.

The backlog of document cataloging is much smaller. Document catalog card production is up to date but cards for 10,000 documents have not been filed into the document catalog for lack of manpower.

It is desirable to reduce the human effort now expended in technical report distribution. This includes maintenance of distribution lists in the Research Information Division, and wrapping, addressing, and mailing. The effort presently required to distribute classified reports seems to be especially objectionable. More highly mechanized techniques would aid in keeping up with the current distribution workload.

The Library should be more effective in retrieving overdue books. Because of lack of manpower to check circulation records and prepare overdue notices, no regular overdue work is currently attempted. Also, book reserves lists need to be kept up to improve circulation services. However, using data-processing equipment for these activities may not be warranted.

It is desirable to gather authoritative information on the scientific information needs of the Library's patrons. Statistics on literature usage can be obtained from circulation records, and used as a guide to future acquisitions policy and collection retirement policy. Information on who uses the Library and what they use could guide thinking on branch activities and special services. Any new circulation control system which is installed should yield useful statistics of this sort.

Supervisory personnel at AFCRL desire the fullest possible use of the Library's fine collection. They are anxious to make their users more aware of available information and where it is to be found. Better announcement and holdings lists, as by automatic means, are desirable. If the mission of the Library should be enlarged there could be a great surge in borrowing and in the demand for the copying service. How to handle an increased service load most efficiently is best determined before the demand reaches full force.

Obviously, the Library could provide all desired services without changing operating methods if it were given more resources--funds, manpower, space. Increased support could produce desired results quickly;

but this is an administrative matter not within the scope of this study. Alternatively, particular services could be dropped in favor of others to make better use of available resources now, without changing techniques. Again, such determinations are beyond the scope of this study.

However, there are three ways within the scope of this study with which the utilization of resources can be improved:

1. By helping the supervisory staff determine relative cost and difficulty of various services now provided, so that the relative emphasis on different services may be changed if necessary.
2. By helping the supervisory staff recognize facets of current activities which do not contribute to performance, and which might be eliminated if not required for administrative purposes.
3. By indicating how work methods might be changed to save resources such as introducing data-processing equipment to reduce manpower requirements and time delays.

Data-processing equipment is of value in any application where there is repetitive action according to fixed rules. It is not a substitute for the creative activity required to establish, evaluate, and modify rules of action. Nevertheless, there are a large number of repetitive activities which invite its introduction:

1. Repetitive recording of information. Most of the records produced by the Library carry a bibliographic description of some piece of scientific literature. Records containing the same description are currently produced over and over by manual effort.

Each time a bibliographic description is recorded manually, it requires not only typing but proofreading, and mismatch with other records due to missed typographical errors becomes possible. If data-processing equipment were introduced at an early stage in record production, bibliographic descriptions could be recorded in machine-useable form to permit rapid automatic accurate retying of the descriptions. Paper-tape reading-punching typewriters or punched-card reading-punching typewriters are ideal for this application: they are among the least expensive data-processing devices and can be operated by persons with typewriter training. Also, machine-readable records can be produced as a by-product of the typing of a human-readable first-stage record.

2. Repetitive extracting or augmenting of records. When new records are produced by copying some older information no longer required, what new information must be added? For example, the purchase-order information which might appear on a receiving record would not be needed on a catalog card or accessions list, but a tracing or call number would be added. Or, if ASTIA's machine-readable cataloging records were available to the library for catalog card production, only a fraction of each record would be required, but an accessions number and perhaps additional file heading would be added. Furthermore, selective augmenting of records is a characteristic of research project control.

Selective extracting and augmenting of machine-readable records while they are being copied can be accomplished on punched-tape typewriters and punched-card devices. The operator allows the machine to run automatically until a deletion or addition is to be made, intercedes to perform the desired operation, and then returns the machine to automatic operation.

However, where the pattern is repetitive, the work may be done entirely automatically by means of punched-tape typewriters with programming capability. Equipment is available which will produce a complete set of catalog cards for an individual title from a single typing of the bibliographic description and of the list of tracings. Presently available devices require that some or all of the punched-tape record be cut and spliced into an endless loop to permit repetitive typing. But this is a distinct improvement over requiring an operator available all the time. It can be further improved by adapting available equipment to eliminate the requirement of cutting tapes to make loops, so that production of a large number of sets of catalog cards can proceed automatically without an operator in attendance. Such capability permits unattended automatic machine operation beyond normal working hours, increasing the return on equipment investment.

Of course, records which are meaningful to simple data-processing machines are also meaningful to the most complex computers. Thus, the same machineusable records used by the simple equipment in the production of conventional human-readable records can be used again without manual transcription when conventional library files are replaced by machine storage.

## 5. RECOMMENDATIONS

It is recommended that:

1. Automatic production of sets of catalog cards by comparatively simple punched-tape data-processing equipment should be introduced on a trial basis. Production should start with monograph catalog cards, for which development of a machine-usable format is well along, and then be extended to documents and serials. The format should have compatibility features to allow for utilization of exchanged punched-tape records. Machine-readable records created for catalog card production can be used later for various other purposes such as announcement list production, charge card production, and pocket labeling.
2. Exchange of machine-readable records among various information processing groups should be developed and encouraged through experiments designed to test the acceptability of machine-readable records to secondary users. A very large portion of the manual effort which goes into original cataloging at libraries could be eliminated if basic catalog records in machine-usable form were received with books and documents. In devising machine record formats, allowance must be made for machine identification of all useful entities if manual reprocessing is to be avoided.
- . Present efforts to obtain LC cards as a basis for monograph cataloging should be reduced. Substantial savings in effort and time may be gained through original cataloging as an

alternative to dependence on LC cards. Greater selectivity is recommended, to limit active card procurement efforts to problem cases where original cataloging is especially difficult. With the introduction of data-processing techniques, all LC catalog cards will have to be recopied into machine-readable format, so only one copy of each card should be ordered.

4. Machine-readable records should be created at the selection stage in processing for subsequent use in the preparation of purchase requisitions, temporary catalog cards, and receiving records. This would require similar procedures to those used in automatic production of catalog cards. The use of records produced at the selection stage might be extended into the cataloging process for certain classes of acquisitions whose bibliographic descriptions are known reliably before actual receipt at the Library.
5. Further study should be given to integrating AFCRL distribution list maintenance activities with technical report distribution activities to reduce overlapping file maintenance effort. High-speed computing and printing equipment could reduce manual effort in updating distribution lists. The basic lists and changes, as well as mailing labels, envelopes, and security control records, could be printed automatically.
6. Further study should be made of the economics of installing data-processing equipment for circulation control and collection of circulation statistics. However, operational and economic aspects must be elucidated, including data-conversion costs, operating costs versus circulation rates, labor savings expected, time factors, and degree of compatibility with other Library data-processing equipment.

7. A study should be made to outline the features of a machine-assisted information system to facilitate more extensive use of the literature collection of the Library. Consideration should be given to future service in which various other types of information are recorded in machine-readable form, and to some of the longer-range operating and service implications of introducing more powerful data-processing equipment.